

TEACHING KATE
TEACHING KIDS ABOUT THE ENVIRONMENT
CONTROLLING OUR COAL CONSUMPTION

Grade Level: 1-8

Time Required: 1 class period

SC Science Standards

This lesson plan was correlated with only the grade level specified unless otherwise noted.

Grade 1:

I. A. 1. a
I. A. 4. a
I. B. 1. a
II. C. 2. b

Grade 2:

I. A. 1. a
I. A. 4. a
I. B. 1. a

Grade 3:

I. A. 1. a
I. A. 4. a
I. B. 1. a
II. C. 2. f
III. A. 1. h
III. B. 1. d

Grade 3:

I. A. 1. a
I. A. 4. a
I. B. 1. a

Grade 5:

I. A. 1. a
I. A. 4. a

Grade 6:

I. A. 1. d, 1
I. A. 7. b, c

Grade 7:

I. A. 1. d, 1
I. A. 7. b, c
III. A. 1. c
III. A. 2. d
III. A. 7. d, e

Grade 8:

I. A. 1. d, 1
I. A. 7. b, c

Purpose

Students will learn about the formation of coal, its uses, advantages and disadvantages. Students will determine that coal resources are limited and nonrenewable.

Skills

Classifying, communicating, concept forming, inferring, observing, predicting.

Concepts

1. Changes over time:
Everything on the earth changes as a result of interactions with the forces (ex. heat and pressure) exerted by other matter. Some changes occur slowly, over millions of years, deep within the earth.
2. Conservation/Technology:
Conservation technology enables humans to maintain and extend the productivity of vital resources (more efficient industrial machines and public awareness of conservation and recycling). Other forms of energy for production of electricity, such as nuclear, are available.

Increased public knowledge of the environment and the need for conservation of natural resources have resulted in lifestyle changes.
3. Renewable and nonrenewable resources:
All people consume products and thereby affect the availability of nonrenewable resources.

Materials Needed

chalk
chalk board
clock (watch with second hand)
2 chocolate chip cookies per student (Chips Ahoy work best)

Definition of Terms

<u>Anthracite Coal</u>	(Hard coal)- Highly desirable fuel because of its high heat content and low sulphur content; supplies are limited in most areas.
<u>Bituminous Coal</u>	(Soft coal) - Extensively used as a fuel because of its high heat content and large supplies; normally has a high sulphur content.
<u>Coal</u>	Solid, combustible material containing 55% to 90% carbon mixed with varying amounts of water and small amounts of compounds containing sulfur and nitrogen. It is formed in several stages as the remains of plants are subjected to intense heat and pressure over millions of years.
<u>Lignite</u>	Low heat content; low sulphur content; limited supplies in most areas.

Nonrenewable Resources Substances such as oil, gas, coal, copper and gold which once used cannot be replaced in this geological age.

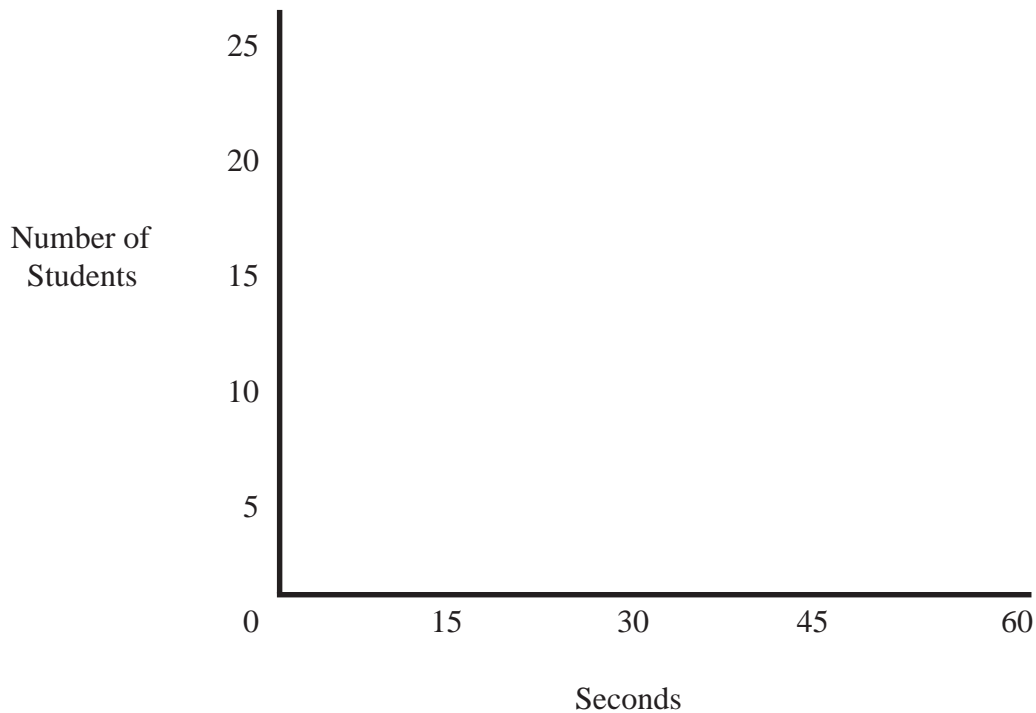
Peat Partially decayed plant and animal matter in swamps and bogs; low heat content.

Renewable Resources A naturally occurring raw material or form of energy which has the capacity to replenish itself through ecological cycles and sound management practices. The sun, wind, falling water, wildlife and trees are examples of renewable resources.

Before the Session

Purchase the cookies. Draw the bar graph shown below on the chalk board. Extend the graph to correct number of students in the class and the number of seconds needed to complete the activity. (2 graphs need to be drawn.)

Graph



Background Information

Coal comes from organic matter, plants, that lived about 300 million years ago.

During the Pennsylvanian Period in the earth's history, the earth was covered with huge swampy forests of giant ferns, reeds and mosses; which grew taller than our tallest trees today. As these plants died and fell into the swamp water, new plants grew to take their place and when these plants died, still others grew. In time, there was a thick layer of dead, decaying plants in the water.

The surface of the earth also changed. Dirt washed into the water covering the dead plants, preventing them from completely decomposing. More plants grew but they too died and fell into the water and formed a separate layer of dead decaying plants. Over time these were also covered with sediments, preventing their complete decomposition. After millions of years many layers had formed, one on top of the other.

The weight of the overlying layers compressed the lower layers of plant matter forming peat. Heat and pressure caused by the overlying sediments produced chemical changes in the peat forcing out oxygen and hydrogen leaving behind rich carbon deposits- coal.

Geologists estimate that a layer of plants 20 feet thick may have been required to form a coal seam one foot thick. Coal seams vary in thickness ranging from only a few inches to more than 100 feet. Four types of coal are formed at different stages: peat, lignite, bituminous coal and anthracite. The last three types are the most widely used. The most desirable type of coal is anthracite because of its high heat content and low sulfur content.

Depending on its location; coal is mined, using shafts, from deep underground deposits or by strip mining deposits which lie near the earth's surface. At our present rate of consumption, it is estimated that world coal reserve's can last about 200 years. Coal is the most abundant fossil fuel. Coal is used to produce electricity. Fifty-six percent of the electricity used in the United States is produced by coal.

Coal is burned in a boiler to heat water and produce steam. Steam turns a turbine (a propeller on a rod). The spinning turbine spins magnets inside loops of wire. This is called a generator. The result is electricity. Coal can also be burned in homes in coal burning stoves and fireplaces to produce heat. Coal also creates more air and water pollution than oil or gas per unit of energy produced by burning it. Bituminous coal produces more pollution than anthracite coal.

Advantages of Coal Usage:

1. Coal is the most abundant conventional fossil fuel in the world and United States.

2. It has a high net useful energy yield for producing high temperature heat for industrial processes and for generating heat.
3. In countries with adequate supplies, burning solid coal is the cheapest way to produce high temperature heat for electricity. These low costs do not include installing and using state-of-the-art pollution control devices on the electricity plants.

Disadvantages of Coal Usage:

1. Coal is dangerous to mine. Surface mining causes severe land disturbance. Surface mined land in arid and semi-arid areas can only be partially restored.
2. Once coal is mined it is expensive to move from one place to another. Currently most coal is transported by railroad. A cheaper method is to transport coal in pipelines as a coal slurry. Coal slurry is made by suspending powdered coal in water. But this method requires enormous amounts of water, a scarce resource in some areas.
3. Coal is the dirtiest fossil fuel to burn. Without expensive air pollution control devices, burning coal produces larger amounts of sulfur dioxide, nitrogen oxides and particulate matter than other fossil fuels.

Suggested Lesson Plan

Part 1

1. Discuss the formation of coal deposits; and the advantages and disadvantages of the use of coal.
2. Give each child one chocolate chip cookie. Instruct them not to eat the cookies until the teacher gives the signal. (**This is not a race**).
3. Tell them to raise one hand and keep it up when they finish their cookie. (Keep hands in the air until activity is over).
4. The teacher should count the raised hands every 15 seconds and record the number. Count the hands in the air until all cookies have been eaten. At the last count, all hands should be raised and counted.
5. Create a bar graph using the data the class has just generated.

Concept Development Phase 1

1. Discuss the information recorded on the graph. Some people eat faster than others, but because there is a limited number of cookies, all are eaten after a period of time and none remain. (Nonrenewable resource.)
2. Now explain to class that one cookie could equal one coal deposit.
3. Analyze the graph.
4. How many “coal deposits” were consumed after 15 seconds? 30 seconds? etc.
5. How many “deposits” were left at the end of the activity?

Part 2

Repeat lesson plan Part 1 with one modification. Have students make a conscious effort to eat slowly. Record the results on the same graph or on a second graph. After 2 minutes, stop activity. All cookies left after this time are to be counted as future reserves.

Concept Development Phase 2

1. Discuss with the students:
 - a. Did your effort to eat more slowly affect the time needed to consume all the cookies (as recorded on the graph)?
 - b. How can you relate this activity to coal conservation?

Note: If the students did not eat more slowly point out the difficulties of voluntary conservation.

- c. What will happen to coal deposits in the United States (and the world) if we do not reduce our coal consumption?
- d. What can we do to improve our rate of coal consumption?
- e. Will our rate of coal consumption affect the type of fuel available for our grandchildren to use?
- f. What other energy forms can be used to produce electricity?
- g. Why is coal considered a nonrenewable resource?

Application

Coal is only one of the world's dwindling resources. It is becoming more important to learn about and use alternate forms of energy production. Continued diligence in searching for new ways to produce energy will always be a significant endeavor unless a perfect solution is someday found. Can the students come up with any alternate ways, we use today, to produce energy? Let students brainstorm ways we might produce energy in the future.

Extension

1. Give each student a third cookie.
2. Have students remove the chips from the cookie (the chips are coal deposits). Students may eat the chips.
3. Now tell the students they must put the cookie back together. This represents restoring the land.
4. When they have finished, discuss the difficulty of restoring disturbed land. Discuss the importance of land restoration despite its difficulty.

Resources Available

Living in the Environment - An Introduction to Environmental Science, 6th edition. 1990. Tyler Miller, Jr. Wadsworth Publishing Co., Belmont, California.

Project Learning Tree Environmental Education Activity Guide, 2nd ed. 1994. American Forest Foundation, 1111 19th St. NW, Washington, D.C. 20036.

Rocks and Soil - How the Weather and Other Forces Change the Earth. 1993. Scholastic Press.

The Energist - Getting to Know Coal. National Energy Foundation Resources for Education, 5160 Wiley Post Way, Suite 200, Salt Lake City, Utah 84116. (801) 539-1406.

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